ARJUNA

JEE

LECTURE - 05

Mole Concept

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TABLE OF CONTENT

01 Atomic weight

02

03

04

Q. How many moles of calcium phosphate, $Ca3(PO_4)_2$ will contain 0.25 mole of oxygen atoms ?

A 3.125×10^{-2}

B 2.5×10^{-2}

C 1.25×10^{-2}

D 0.02

Ans batao ⇒ 40sec

No. of mole of O-atom = 8 × No. of mole $Ca_3(PO4)_3$

$0.25 = 8 \times$ No. of mole of $Ca_3(PO4)_3$

No. of mole of $Ca_3(PO4)_3 = \frac{0.25}{8} = \frac{25}{8} \times 10^{-2} = 3.125 \times 10^{-2}$

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Q. The valume occupied by 4.4 g of CO_2 at STP is

A 22.4 L

B 0.224 L

C 2.24 L

D 0.1 L

Ans batao

$\frac{4.4}{44} = 0.1$ mole

1 mole = 22.4 litre at S.T.P

0.1 mole = 2.24 litre at S.T.P

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A_xB_y

No. of mole of A = x × No. of mole A_xB_y

No. of atoms of A = x × No. of mole A_xB_y × N_A

Atomic weight = Mass of one atom in gram

→ Mass of $e^- = 9.1 \times 10^{-31}$ kg

→ Mass of $p^+ = 1.6 \times 10^{-27}$ kg

→ Mass of $n^0 = 1.6 \times 10^{-27}$ kg

Ex → one H-atom = Atomic Number = 1
Mass number = 1

$_1H^1$

$_1H^1$ → No. of proton = 1

Atomic Number ⇒ total No. of proton present in atom

Mass number (A) = p + n

No. of proton + No. of neutron

$A = p + n$

$1 = 1 + n$

$n = 0$ → No. of neutron

Q → Calculate mass of 1 atom of H (Z=1 , A=1)

(a) 1 gram

(b) 1.6×10^{-24} gram

(c) 1 gram

(d) None of these

Sol^{n} → H-atom = H^{1} → A=1

↳ Z=1

$C_{SD} = 13$

total Mass of 1 atom in gram = A × 1.6×10^{-24} gram

= A × 1.6×10^{-27} Kg

Q → Calculate mass of one C-atom $\left({}_{6}C^{12},\ Z=6,\ A=12 \right)$

(a) 12 gram

(b) 6 gram

(c) ✓ $12 \times 1.6 \times 10^{-24}$ gram

(d) $6 \times 1.6 \times 10^{-24}$ gram

Soln

total Mass of one C-atom = $A \times 1.6 \times 10^{-24}$ gram

$= 12 \times 1.6 \times 10^{-24}$ gram

Relative Atomic weight (R.A.M) or Mass

Q → Calculate mass of $\frac{1}{12}$ part of one C-atom ($_6C^{12}$, A=12)

Soln → Mass of one C-atom = $12 \times 1.6 \times 10^{-24}$ gram

Mass of $\frac{1}{12}$ part of one C-atom = $\frac{12 \times 1.6 \times 10^{-24}}{12}$ gram

$= 1.6 \times 10^{-24}$ gram

$$1\ amu = 1\ atomic\ mass\ unit = 1\ \mu = \frac{1}{12} \times \text{Mass of one C-atom } ({}_6C^{12})$$

$$1\ amu = 1.66 \times 10^{-24}\ gram = \frac{1}{N_A}\ gram$$

$$= \frac{1}{6.022 \times 10^{+23}} = \frac{10 \times 10^{-24}}{6.022}$$

$$= 1.66 \times 10^{-24}$$

Relative Atomic Mass (R.A.M)

Atomic mass of an element can be defined as the number which indicates how many times the mass of one atom of the element is heavier in comparison to $\frac{1}{12}$th part of the mass of one atom of Carbon-12. (1amu)

$$Atomic\ mass = \frac{[Mass\ of\ an\ atom\ of\ the\ element]}{\frac{1}{12} \times [Mass\ of\ an\ atom\ of\ carbon-12]} = \frac{Mass\ of\ an\ atom\ in\ amu}{1\ amu}$$

* R.A.M = number (unitless quantity)

Ex→ Relative atomic mass of Carbon = 12

$C_{SD}=14$

1. * $1\,amu = 1\mu = \frac{1}{N_A}\,gram = 1.66\times10^{-24}\,gram$

2. * Mass of one atom in gram $= A\times1.6\times10^{-24}\,gram$

3. * Relative Atomic mass = $\frac{\text{Mass of single atom of element}}{\frac{1}{12}\times\text{Mass of one C-atom } (_6C^{12}) \text{ or } 1amu}$

   R . A . M

4. * R . A . M = Atomic Mass Number without Unit = Value of 'A'

   Ex→ R.A.M of O-atom = 16

   $_8O^{16}$

Q Select the correct value of Relative atom mass of N-atom $(_7N^{14})$
(R.A.M.)

(a) 14 gram

(b) 14 amu

(c) 14

(d) all correct

R.A.M = value of A = 14

Q → Calculate mass of one O-atom in term of amu.

Sol^{n} → Mass of one O-atom = A × 1.6×10^{-24} gram

Mass of one O-atom = A × 1amu
= A amu

where → 1amu = 1.6×10^{-24} gram

⇒ Mass of one O-atom = 16amu

Q- Calculate mass of 1mole or Avogadro's Number (6.022×10^{23}) number of O-atom.

Sol^{n}. Mass of one O-atom = A × 1.6×10^{-24} g

Mass of one O-atom = A × $\frac{1}{N_A}$ gram

N_A O-atom (1mole O-atom) =

$A \times \frac{1}{N_A} \times N_A$ gram

= A gram

Mass of 1mole = 'A' gram = 16gram

$C_{SD} = 15$

→ Mass of single atom = A in term of amu = A amu or A u

→ Mass of 1 mole atom = A in term of gram = A gram

→ Relative Atomic Mass of atom = A without unit = A

Q Match the following

List-1		List-2	
(a)	Relative Atomic Mass	(p)	12 gram
(b)	Mass of one atom	(q)	12
(c)	Mass of 1 mole	(r)	12 u
		(s)	16 u
		(t)	16 gram
		(u)	7

a → q, u

b → r, s

c → p, t

Q → R.A.M = $\frac{\text{Mass of single atom}}{\frac{1}{12} \times \text{mass of one C-atom}}$, If $\frac{1}{12}$ replace by $\frac{1}{6}$,

than select correct option.

(a) Value of R.A.M is double

(b) Value of R.A.M is half

(c) Value of R.A.M unchange

(d) Value of R.A.M. 6 times

Average Atomic weight

→ all atom have isotopes

Ex → H
- $_1H^1$ → protium (H) → 99.9%
- $_1H^2$ → Deuterium (D) → 0.0156%
- $_1H^3$ → Tritium (T) → 10^{-15} %

Ex → 1gram Hydrogen → all isotopes present

Book → H = 1.008

Ex → Atomic mass Cl-atom = 35.5

Cl
- $_{17}Cl^{35}$
- $_{17}Cl^{37}$

$$\text{Avg. Atomic Mass} = \frac{\sum A_i X_i}{\sum X_i} = \frac{A_1X_1 + A_2X_2 + A_3X_3 - - -}{X_1 + X_2 + X_3 - - -}$$

Where A_i = Atomic mass of different isotopes

X_i = Mass % or Mole % or Mole or Numbers or Mass ratio or Mole ratio } of isotopes

Q → X → two isotopes A^{10} & B^{20}

(a) 1 mole A + 2 mole B ⟶ $\frac{\sum A_i x_i}{\sum x_i} = \frac{10\times1 + 20\times2}{1+2} = \frac{50}{3}$

(b) 10 molecule A + 20 molecule B ⟶ $\frac{10\times10 + 20\times20}{10+20} = \frac{100+400}{30} = \frac{500}{30}$

(c) 25% A + 75% B ⟶ $\frac{25\times10 + 75\times20}{25+75} = \frac{250+1500}{100} = \frac{1750}{100}$

(d)

Q Calculate Avg. atomic wt. of U-atom. If U-has two isotopes (25% $_{17}U^{35}$ and 75% $_{17}U^{37}$.

(a) 35.5

(b) 36

(c) 36.5 ✓

(d) None of these

Soln Avg. Atomic Mass of U-atom

$$= \frac{\Sigma A_i x_i}{\Sigma x_i} = \frac{A_1 x_1 + A_2 x_2}{x_1 + x_2}$$

$$= \frac{35 \times 25 + 37 \times 75}{25 + 75}$$

$$= 36.5$$

$C_{SD} = 16$

① Avg. Atomic Mass $= \dfrac{\sum A_i x_i}{\sum x_i} = \dfrac{A_1 x_1 + A_2 x_2 + \cdots}{x_1 + x_2}$

$A_i \rightarrow$ Atomic mass of isotopes

$x_i \Rightarrow$ mole, Mass %, mass, number, mass ratio, mole ratio of different isotopes

⇒ ② $A_{min} < A_{avg} < A_{max}$

⇒ ③ Jis isotope ka percentage (%) jada hoga, Avg. Atomic mass Usi ke pas ayega.

Q. Boron has two stable isotopes, ^{10}B (19%) and ^{11}B(81%). Calculate average atomic weight of boron in the periodic table

A 10.8

B 11.2

C 10.2

D 10.0

Ans batao → 20sec

① $A_{min} < Avg < A_{max}$

② % - jada → Avg pas hoga

Avg. Atomic Mass $= \frac{19\times10+11\times81}{19+81}$

$= \frac{190+891}{100} = \frac{1080}{100}$

$= 10.8$

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Q Cu has 2-isotopes, $_{29}Cu^{63}$ → 70%

$_{29}Cu^{65}$ → 30%

Calculate Avg. Atomic mass of Cu.

(a) 63 ✗

(b) 65 ✗

(c) 63.5

✓ (d) None of these

→ $63 < Avg < 65$

Avg. Atomic Mass = $\frac{70 \times 63 + 65 \times 30}{70 + 30}$

= 63.6

Q. Average atomic mass of magnesium is 24.31 amu. A sample of magnesium is composed of 79 mole % of ^{24}Mg, 11% mole % of ^{25}Mg. The number of moles % of ^{26}Mg in a sample of magnesium is

A ✓ 10

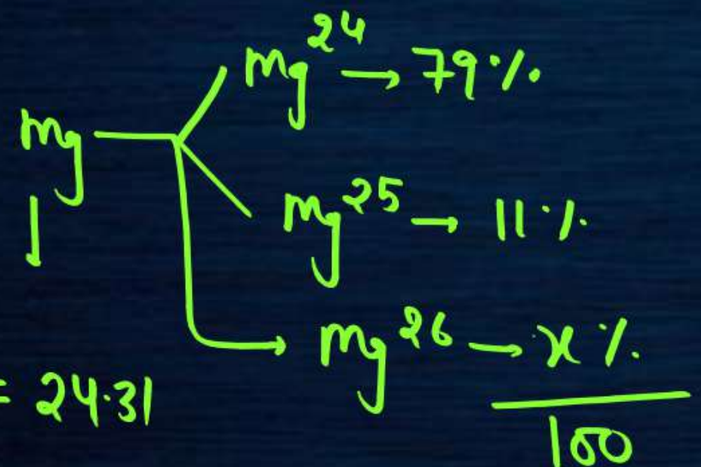
B 15

C 11

D 16

→ always percent ka total sum 100 hota.

(M-2)



Avg = 24.31

$$24.31 = \frac{24\times79 + 25\times11 + 26\times x}{79+11+x}$$

$$\frac{x}{100}$$

$79+11+x = 100$

$x = 10\%$

$x = 10\%$

Home work

→ DPP-03

→ DPP-04

Thank - You